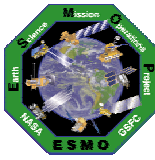




Aura Science Team Meeting

Boulder, Colorado

September 11 - 15, 2006



EOS Aura Mission Operations Working Group (MOWG) Meeting

Angelita C. Kelly

Earth Science Mission Operations Project

Science Interface Manager

Constellation Team Manager

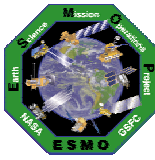
NASA/Goddard Space Flight Center

Greenbelt, Md. 20771



EOS AURA Mission Operations Working Group Meeting

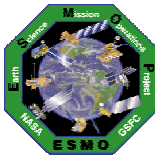
Boulder, Colorado, September 12, 2006



13:00	Greetings/Introduction/Agenda Review	All
13:15	EOS Aura Status	A. Kelly
13:30	HIRDLS	J. Craft/J. Barnett/ C. Hepplewhite
13:50	MLS	D. Miller/D. Cuddy
14:10	OMIS	J. Claas
14:30	TES	R. Murdock
15:00	MMS IST Redesign and New Operations Concept	Raytheon
15:40	EDOS Update	C. Gomez
16:00	SSR Auto Operations Concept	A. Kelly
16:30	Summary/Actions/Next Steps	
17:00	Adjourn	



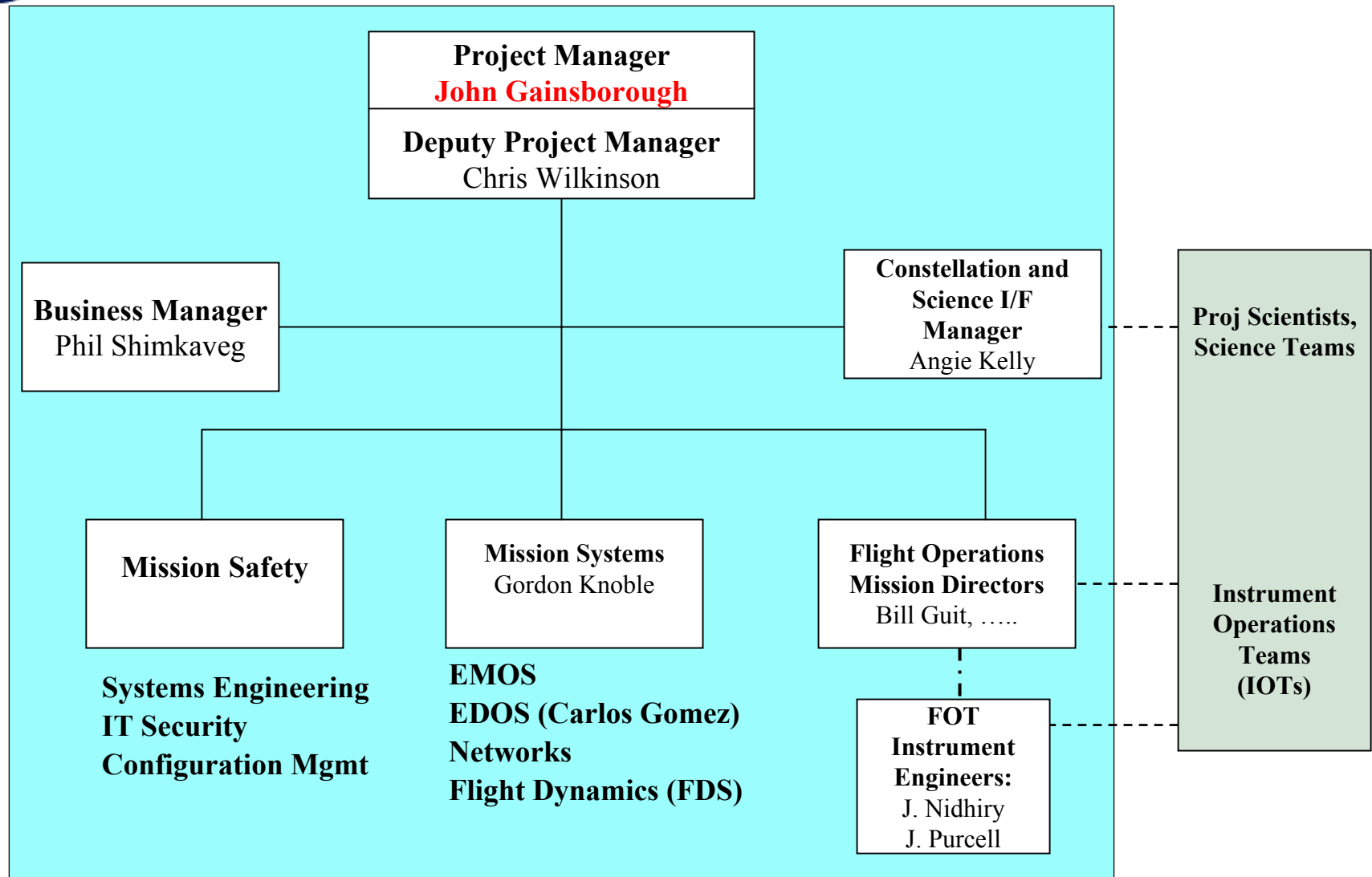
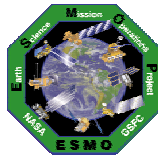
TOPICS



- ESMO Organization Update
- Aura's Neighborhood
- Aura Mission Operations Status
- Data Losses
- ESMO's Cost Reduction Activities/Plans
- Summary

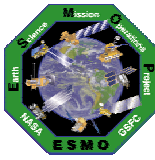


GSFC Earth Science Mission Operations (ESMO) Organization



- - - - = contractor interface

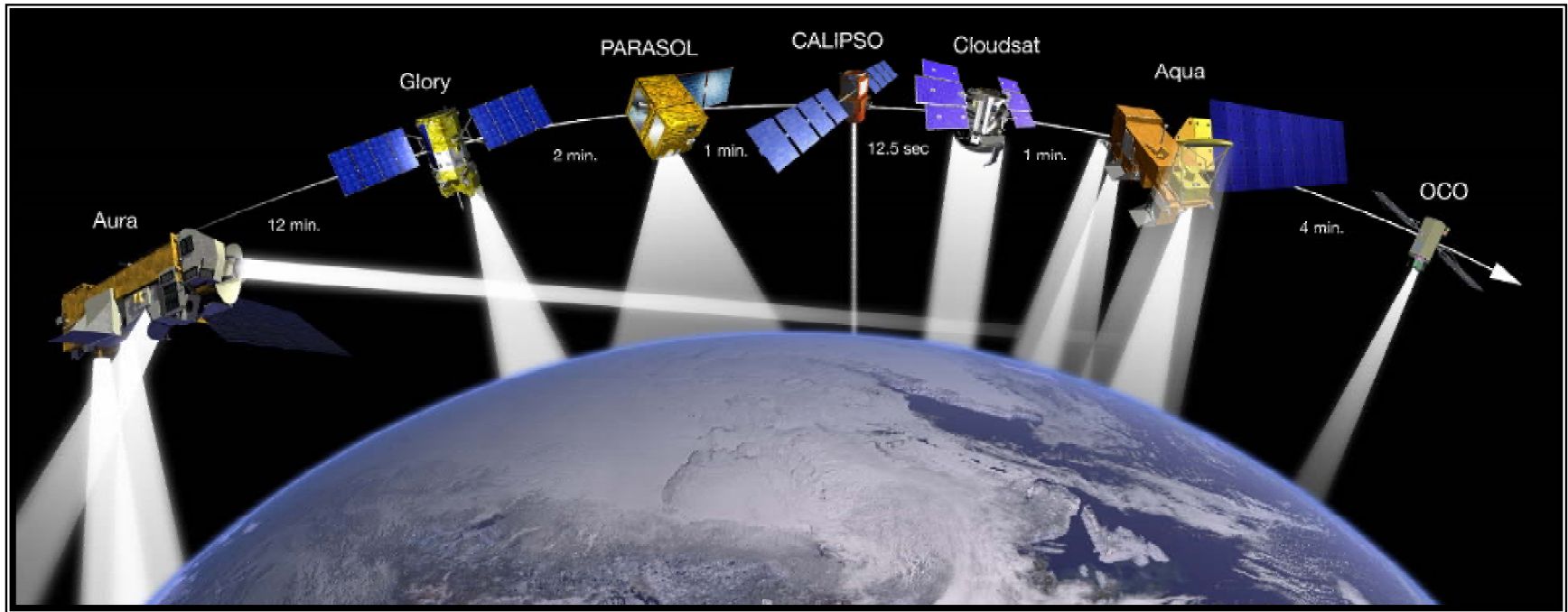
 = external interfaces



Aura's Neighborhood



Earth Science Afternoon Constellation (A-Train)



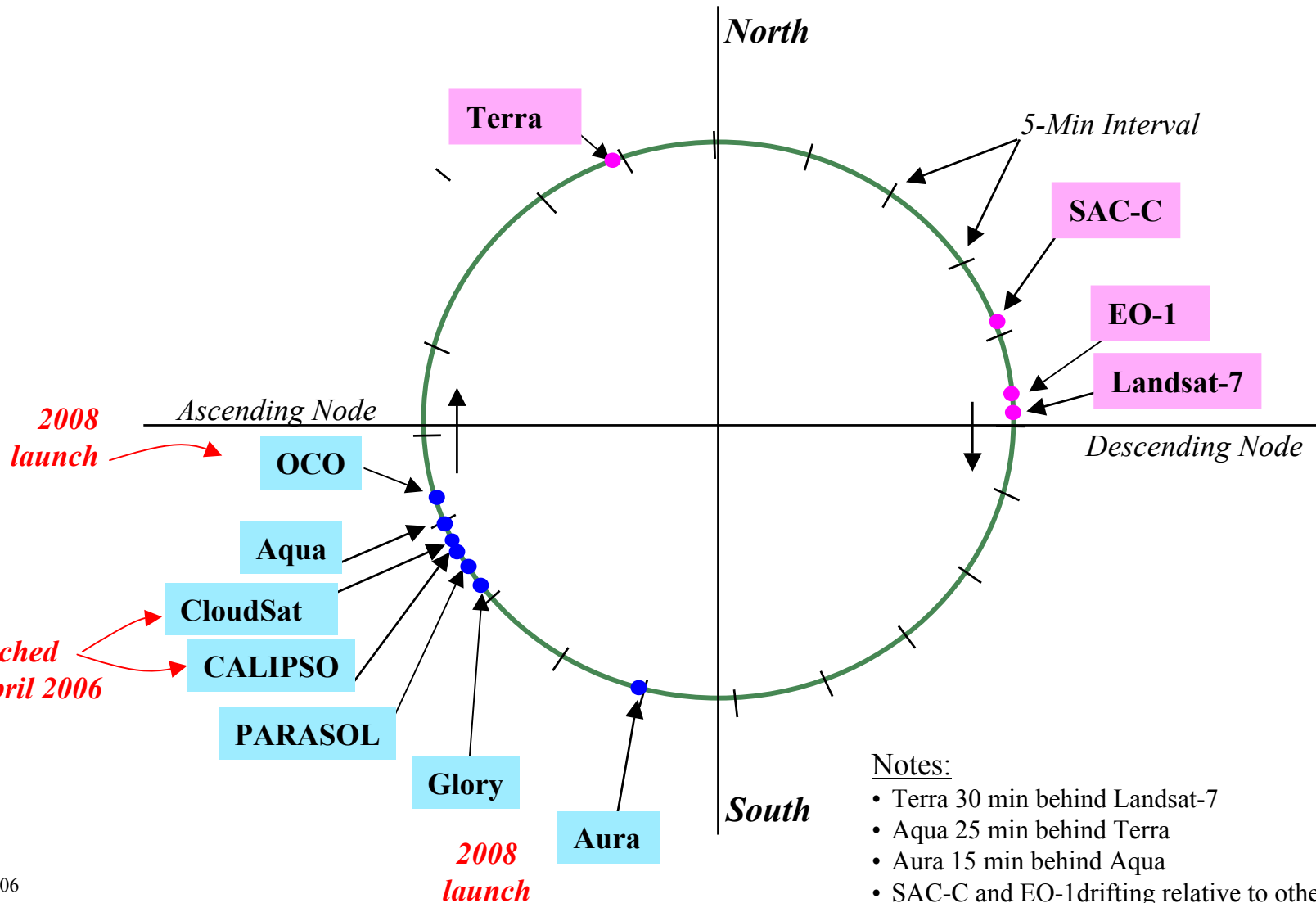
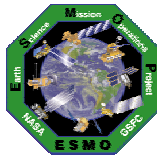
- **CloudSat and CALIPSO** were launched 28 April 2006
-- joined the Afternoon Constellation May 31.
- There are now **5 on-orbit satellites** in the “A-Train”.
- **Glory** planning to be **~4 minutes** behind Aqua
- **OCO and Glory missions will launch in late 2008**
- All A-Train satellites currently performing Inclination Adjust Maneuvers



Relative Positions of Satellites (one orbit)

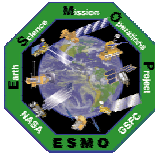
Earth Science Morning and Afternoon Constellations

(From Ground Station Perspective)





Coordinated Constellation Inclination Adjust Maneuvers

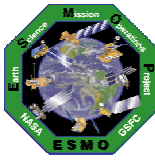


(Aug/Sep/Oct 2006)

Sun	Mon	Tue	Wed	Thu	Fri	Sat
13 August	14	15	16 Telecon	17	18	19
20	21	22 Aqua IAM #8	23 Telecon PARASOL #1	24 Aura IAM #5	25	26 CS #1
27	28	29 Aqua IAM #9 CALIPSO #1	30 Telecon	31 Aura IAM #6	01 September CS #2	02
03	04 HOLIDAY	05	06 PARASOL PBM	07 Aqua IAM #10	08	09
10	11 Telecon Ideal Date	12 Aqua IAM #11	13 PARASOL #2	14 Aura IAM #7	15	16
17	18	19 Aqua IAM #12 CALIPSO BM	20 Solar Eclipse PARASOL #3	21 Aura IAM #8 Telecon	22	23 Equinox
24	25	26 Aqua IAM #13 CloudSat #3	27 Telecon PARASOL #4	28 Aura IAM #9	29 CALIPSO #2	30
01 October	02 CloudSat #4	03 Aqua Back-Up	04 Telecon	05 Aura IAM #10	06	07
08	09 HOLIDAY	10	11 Telecon	12 Aura Back-Up	13	14



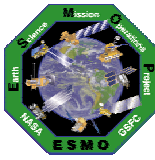
EOS Aura



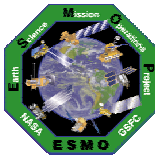
Mission Operations Status



Since our last meeting....



- 11/08/05: Science Team Meeting & MOWG, Den Haag
- 12/02/05: TES Optical Bench Warm Up
- 12/31/05: Leap Second
- 02/15/06: MLS Band 13 Shutdown (modified ops concept)
- 02/28/06: OMI FMM Anomaly (modified ops concept)
- 03/29/06: MLS Anomalous AAA Movement
- 04/07/06: MLS Band 10 and 29 Shutdown (on for polar winter)
- 04/14/06: Expanded Direct Broadcast (increased DB data)
- 04/28/06: CloudSat & CALIPSO Launched
- Mid-May: IST Incident, New Online Interface, etc.....
- 06/07/06: Norway Communications Outage--Data Loss
- 07/05/06: Norway Communications Outage--Data Loss
- **07/15/06: 2-Year Anniversary**
- 08/31/06: TES Filter Wheel Anomaly (nominal ops 9/9)

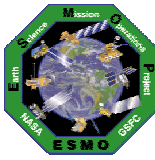


Instruments

- Instrument Status - **GREEN**
 - HIRDLS: Operating Normally
 - Collecting data through reduced aperture
 - Next Pitch Maneuver November 3, 2006
 - MLS: Operating Normally
 - Band 13 measurements currently suspended
 - OMI: Operating Normally
 - Resumed Normal Operations on June 12, 2006
 - TES: Operating Normally
 - Resumed normal operations on September 9, 2006



Spacecraft Subsystems

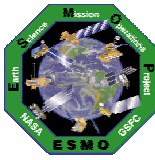


- Command & Data Handling (CDH) – **Nominal**
 - Solid State Recorder (SSR) – holds 3 orbits of data
- Communications (COMM) - **Nominal**
- Electrical Power System (EPS) – **Nominal**
 - *Solar Panel Connector Anomaly (January 12, 2005)*
- Flight Software (FSW) - **Nominal**
- Guidance, Navigation & Control (GN&C) - **Nominal**
- Propulsion (PROP) - **Nominal**
- Thermal Control System (TCS) – **Nominal**

All subsystems configured to primary hardware.



Activities

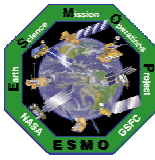


- Current/Ongoing
 - 6 Inclination Adjust Maneuvers (IAMs)
 - August 24 & 31st -- completed
 - September 14th, 21st & 28th
 - October 5th & 12th (Back-Up Date)
- Planned
 - Nov 3rd – HIRDLS Pitch Maneuver

Note: IOTs need to provide ESMO a schedule of future campaigns or special activities on a regular basis.



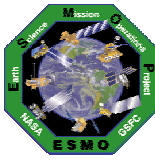
Data Losses



- June 7, 2006 – Norway Communications Outage
 - Service provider disrupted service on the redundant circuit while trouble-shooting a problem on the prime circuit.
 - **Instrument Science Data Losses: (~52 min)**
 - HIRDLS 158/03:56:40 – 04:48:14 GMT
 - MLS 158/03:56:39 – 04:48:14 GMT
 - OMI 158/03:57:04 – 04:58:51 GMT
- July 5, 2006 – Norway Communications Outage
 - **Instrument Science Data Losses: (4^h 22^m 07^s)**
 - HIRDLS 186/01:04:28 – 05:10:38 GMT
 - MLS 186/01:04:28 – 05:10:38 GMT
 - OMI 186/01:04:57 – 05:27:04 GMT
 - TES No TES Data Loss (TES was between GS observations)



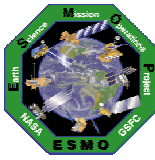
End of Mission Requirement (Fuel needed to ensure re-entry in 25 years)



S/C	Flux level	Perigee Height (Km)	Minimum Fuel Required (kg)	Current Fuel Level (kg)
Aqua	Low	433	125	179
Aqua	Nominal	491	95	
Aura	Low	438	114	191
Aura	Nominal	491	95	

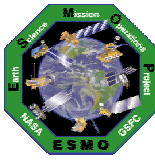
Worst case analysis for Aura indicates **minimum of 8-10 years of remaining life – saving 114 kg of fuel for EOM**

ESMO Flight Dynamics analysis indicates Aura has sufficient propellant reserves to last until 2015



Summary

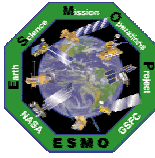
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 - Band 13 measurements currently suspended
 - OMI: Operating Normally
 - Resumed Normal Operations on June 12, 2006
 - TES: Operating Normally
 - Resumed normal operations on September 9, 2006
- Data Capture/L0 Processing Status – **GREEN**
 - **SSR Data Capture to 07/31/2006: 99.67 %**



ESMO'S Cost Reduction Activities/Plans



ESMO's Cost Reduction Activities/Plans

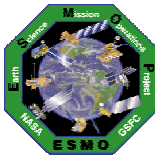


To cope with ESMO's shrinking operations budget:

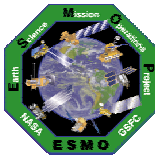
- Aqua/Aura “Single-S/C-Ops”
 - Same FOT staff for Aura and Aqua spacecraft operations
 - Takes advantage of spacecraft bus similarities
- Aqua/Aura Solid State Recorder Auto Ops (“Dump-N-Go”)
 - Eliminates the need for ground commanding for normal SSR operations
 - Provides a capability to receive science data in the event of a major communication outage
 - Science Teams have concerns over data losses due to Auto Ops
 - **ESMO management needs feedback from science teams**
- Aqua/Aura Automation (“Lights-Dim” Ops)--long term
 - Goal is for one person staffing during off-shift operations with “fire-watch” approach to anomalies and data losses



Reminder



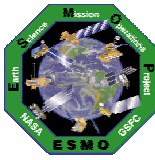
The IOTs and the FOT must continue to be diligent in performing their day-to-day activities to ensure the safety of the spacecraft and the instruments. Negligence can kill the instrument and/or spacecraft.



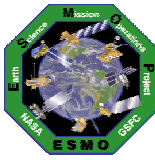
Additional Information



Old Spacecraft Anomalies

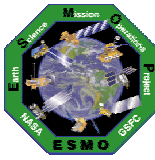


- EPS ARE-3C not supplying power to S/C Bus
 - Started January 12, 2005: Degraded to zero output in 4 orbits
 - No interruption to S/C or Instrument Operations
 - ESMO Anomaly Resolution Team Formed
 - NGST, AETD, FOT, MD
 - ARE-3C taken off-line March 10, 2005
 - GSFC/AETD Anomaly Review Board Final Report
 - Most Likely Cause: **Disengaged Solar Array connector**
 - Believed to be an isolated workmanship related problem
 - **Impact: Available End of Life (EOL) power margin dropped from 24% to 17%**
 - **No impact to operations or 6-year life expectancy**



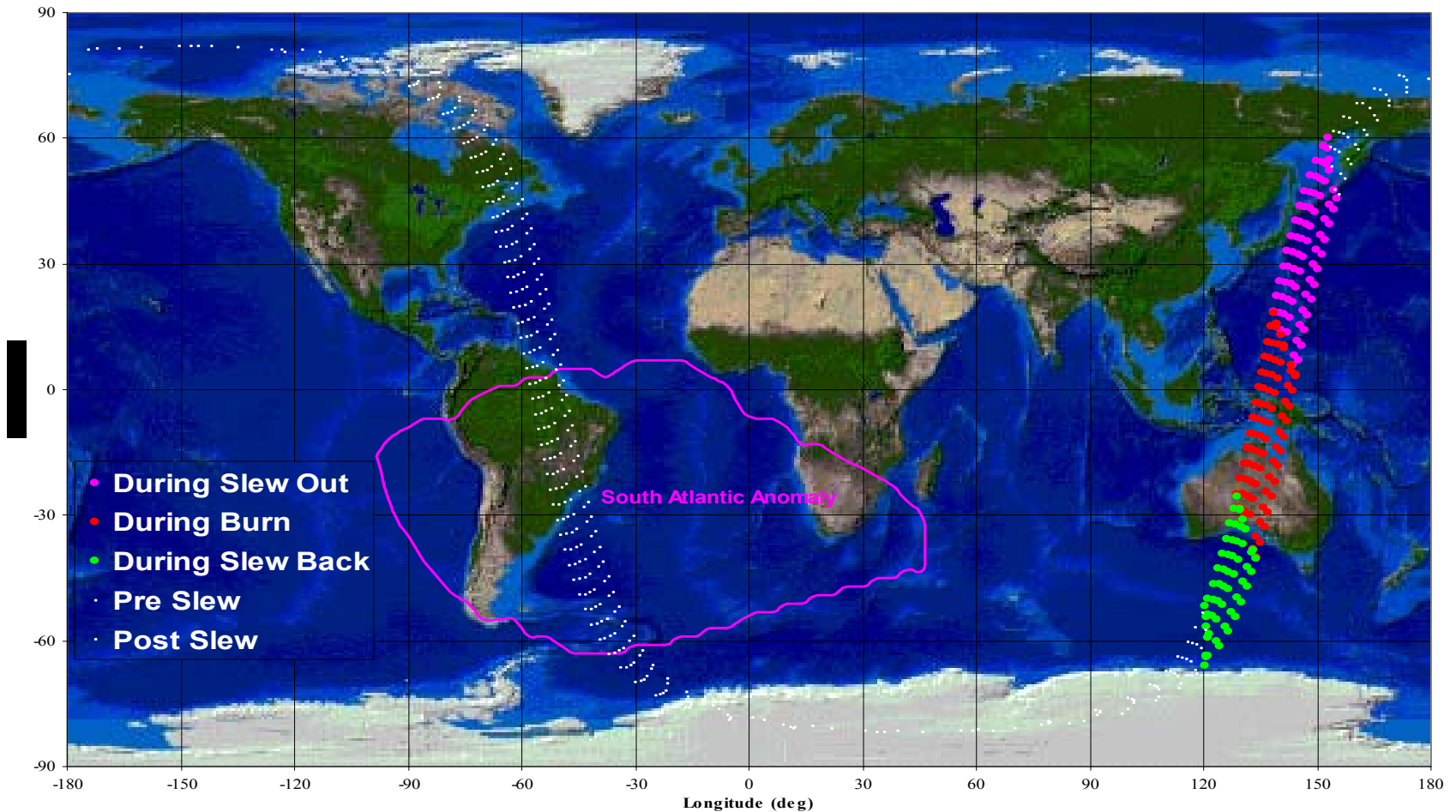
2005 Major Events

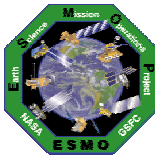
- 01/12/05: Solar Array Anomaly
- 02/01/05: HIRDLS Transition to ESMO
 - HQ review 02/11/05
- 03/02/05: Science Team Meeting
- 04/11/05: TES Operations Suspended
- 05/26/05: TES ICS Velocity Anomaly
- 07/15/05: 1-Year Anniversary
- 09/13/05: TES Operations Suspended
 - Review at JPL 10/19/05



Maneuver Locations

Aura Fall 2006 Inclination Maneuver Location





Propellant Usage

